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**BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application Number: 10/527,115
Filing Date: March 08, 2005
Appellant(s): LOBL ET AL.

Jeffrey T. Homan
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 04/26/010 appealing from the Office action mailed 11/25/2010.

**(1) Real Party in Interest**

The examiner has no comment on the statement, or lack of statement, identifying by name the real party in interest in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The following is a list of claims that are rejected and pending in the application: Claims 7-10 and 15-24.

**(4) Status of Amendments After Final**

The examiner has no comment on the appellant's statement of the status of amendments after final rejection contained in the brief.

**(5) Summary of Claimed Subject Matter**

The examiner has no comment on the summary of claimed subject matter contained in the brief.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The examiner has no comment on the appellant's statement of the grounds of rejection to be reviewed on appeal. Every ground of rejection set forth in the Office action from which the appeal is taken (as modified by any advisory actions) is being maintained by the examiner except for the grounds of rejection (if any) listed under the subheading "WITHDRAWN REJECTIONS." New grounds of rejection (if any) are provided under the subheading "NEW GROUNDS OF REJECTION."

**(7) Claims Appendix**

The examiner has no comment on the copy of the appealed claims contained in the Appendix to the appellant's brief.

**(8) Evidence Relied Upon**

| | | |
|---|---|---|
| 6,734,763 | Nishihara et al. | 5-2004 |
| 5.936.150 | Kobrin et al. | 8-1999 |

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

1. Claims 7-8 and 16 are rejected under 35 U.S.C. 102(e) as being anticipated by Nishihara et al.

Nishihara et al. teach in figure 21 and related text a bulk acoustic wave (BAW) resonator comprising:

a top electrode 823;

a piezoelectric layer 822 disposed adjacent to the top electrode;

a bottom electrode 821 disposed adjacent to the piezoelectric layer, wherein the bottom electrode is disposed opposite the top electrode relative to the piezoelectric layer; and

a substrate 810 disposed opposite the piezoelectric layer relative to the bottom electrode, wherein the substrate comprises an uneven surface (column 3, lines 6-7) to suppress a spurious mode (inherently therein), wherein

the uneven surface is on a rear side of the substrate facing away from the bottom electrode, and wherein:

the top electrode comprises a first metal material; the piezoelectric layer comprises at least one of a plurality of piezoelectric material; and the bottom electrode comprises a second metal material.

2. Claims 7-8 and 16-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishihara et al.

Regarding claims 7-8 and 16, Nishihara et al. teach in figure 21 and related text a bulk acoustic wave (BAW) resonator comprising:

a top electrode 823;

a piezoelectric layer 822 disposed adjacent to the top electrode;

a bottom electrode 821 disposed adjacent to the piezoelectric layer, wherein the bottom electrode is disposed opposite the top electrode relative to the piezoelectric layer; and

a substrate 810 disposed opposite the piezoelectric layer relative to the bottom electrode, wherein the substrate comprises an uneven surface (column 3, lines 6-7) to suppress a spurious mode (inherently therein since it has an uneven surface), and

wherein: the top electrode comprises a first metal material; the piezoelectric layer comprises at least one of a plurality of piezoelectric material; and the bottom electrode comprises a second metal material.

Nishihara et al. do not explicitly state that the substrate has an uneven surface, wherein the uneven surface is on a rear side of the substrate facing away from the bottom electrode.

Nishihara et al. teach in column 3, lines 6-7 that the surface roughness of a sacrifice layer is greater than that of the substrate.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a substrate with an uneven surface, wherein the uneven surface is on a rear side of the substrate facing away from the bottom electrode in Nishihara et al.'s device in order to form the device as understood by Nishihara et al.'s teachings, and in order to improve the device characteristics by improving the adhesion between the substrate and the device structure (by having the uneven surface on a rear side of the substrate), respectively.

Note that forming the uneven surface on a back side or rear side of the substrate facing away from the bottom electrode, does not necessarily mean that the "rear side" of the substrate is the side which is not attached to any other layer, because both sides of the substrate are "facing away from or opposite the bottom electrode".

Regarding claims 17-19, Nishihara et al. do not state in the embodiment of figure 21 and related text substantially the entire claimed structure, as applied to the claims above, except the first metal material of the top electrode comprises aluminum (Al), wherein the plurality of piezoelectric materials comprises aluminum nitride (AlN), zinc oxide (ZnO), and lead zirconate titanate (PZT), and wherein the second metal material of the bottom of electrode comprises molybdenum (Mo), platinum (Pt), or tungsten (W). Nishihara et al. teach in column 4 a first metal material of the top electrode comprises aluminum (Al), wherein the plurality of piezoelectric materials comprises aluminum nitride (AlN), zinc oxide (ZnO), and lead zirconate titanate (PZT), and wherein the second metal material of the bottom of electrode comprises molybdenum (Mo), platinum (Pt), or tungsten (W).
It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form the first metal material of the top electrode comprises aluminum (Al), wherein the plurality of piezoelectric materials comprises aluminum nitride (AlN), zinc oxide (ZnO), and lead zirconate titanate (PZT), and wherein the second metal material of the bottom of electrode comprises molybdenum (Mo), platinum (Pt), or tungsten (W), in Nishihara et al.'s device, in order to reduce to cost of the device

by using conventional materials for the top electrode, the plurality of piezoelectric materials and for the bottom of electrode.

Regarding claims 20-21 and 23-24, Nishihara et al. teach in figure 21 and related text substantially the entire claimed structure, as applied to the claims above, including a first BAW resonator to suppress a pass-band ripple of a spurious mode, wherein the BAW resonator comprising a substrate with an uneven surface to suppress a spurious mode.

Nishihara et al. do not teach in the embodiment of figure 21 a second BAW resonator connected to the first BAW resonator, wherein the second BAW resonator is used to suppress the pass-band ripple of a spurious mode.

Nishihara et al. teach a second BAW resonator connected in a ladder configuration to the first BAW resonator (column 1, lines 45-48).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to connect a second BAW resonator to suppress the pass-band ripple of a spurious mode in a ladder configuration to the first BAW resonator in Nishihara et al.'s device, in order to improve the filtering characteristics of the device when it is used in a filter application.

Regarding claim 22, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to connect the second BAW resonator in a lattice

configuration to the first BAW resonator in Nishihara et al.'s device, in order to use the device in a filter application which require lattice configuration.

3. Claims 9-10 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nishihara et al. in view of Kobrin et al.

Regarding claims 9-10, Nishihara et al. teach in figure 21 and related text substantially the entire claimed structure, as applied to the claims above, the roughened surface of the substrate comprises an etched surface of glass and a blasted layer of glass. Kobrin et al. teach in figure 3 and related text a substrate 12 comprises an etched surface of glass and a blasted layer of glass.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a glass substrate in Nishihara et al.'s device, in order to use the device in an application which require insulating substrate.

Regarding the process limitations recited in claims 9 and 10 ("an etched surface of glass and a blasted layer of glass"), these would not carry patentable weight in this claim drawn to a structure, because distinct structure is not necessarily produced. Note that a "product by process" claim is directed to the product per se, no matter how actually made, In re Hirao, 190 USPQ 15 at 17 (footnote 3). See also In re Brown, 173 USPQ 685; In re Luck, 177 USPQ 523; In re Fessmann, 180 USPQ 324; In re Avery, 186 USPQ 161; In re Wertheim, 191 USPQ 90 (209 USPQ 554 does not deal with this issue); and In re Marosi et al., 218 USPQ 289, all of which make it clear that it is the patentability of the final product per se which must be determined in a "product by

process" claim, and not the patentability of the process, and that an old or obvious product produced by a new method is not patentable as a product, whether claimed in product by process claims or not. Note that the applicant has the burden of proof in such cases, as the above case law makes clear.

Regarding claim 15, Nishihara et al. do not teach a Bragg reflector disposed between the substrate and the bottom electrode.
Kobrin et al. teach in figure 3 and related text a Bragg reflector disposed between the substrate and the bottom electrode.
It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a Bragg reflector disposed between the substrate and the bottom electrode in Nishihara et al.'s device, in order to use the device in an application which require reflecting layers.

**(10) Response to Argument**

1. Appellant argues on pages 6-8 that Nishihara does not disclose *"an uneven surface on a rear side of the substrate facing away from the bottom electrode"*, because *"Although Nishihara indirectly mentions a surface roughness of a silicon substrate relative to the surface roughness of the sacrifice layer described in reference to Fig. 21, Nishihara does not state which surface of the substrate might have the surface roughness"*.

Appellant then argues that *"it appears that Nishihara implicitly refers to the top surface of the substrate on which the sacrifice layer is disposed to form the cavity"*, because *"Nishihara compares the*

*surface roughness of the sacrifice layer to that of the substrate on which the sacrifice layer is disposed. Nishihara specifically describes forming a polished and clean surface in each of the resonator cavities. Nishihara, col. 3, lines 12-27. Nishihara also explains that the orientation of the lower electrode would deteriorate which would make obtaining good resonance characteristics difficult. Moreover, Nishihara describes the formation of smooth features on the resonator results in a production efficiency that is substantially higher. Nishihara, col. 6, lines 6-16".* Appellant concludes that *"Therefore, the only correlation between the sacrifice layer and the substrate appears to be on the top surface (i.e., the surface closest to the cavity and the electrodes in Fig. 21). In contrast, there appears to be no correlation between the surface roughness of the sacrifice layer and the bottom surface of the substrate (i.e., the surface furthest from the cavity and the electrodes in Fig. 21)".*

Appellant further argues that since Nishihara does not disclose an uneven surface on a rear side of the substrate, then "Nishihara fails to disclose an uneven surface to suppress a spurious mode".

1. Nishihara et al. recite in column 3, lines 4-6 *"the sacrifice layer, formed to have a thickness corresponding to the length L15, has a greater surface roughness than that of the silicon substrate 810".* The examiner agrees that Nishihara et al. do not explicitly state which surface of the substrate has a surface roughness. However, the examiner takes the position, for reasons which are explained below, that since Nishihara et al. do not explicitly state which surface has a surface roughness, then the entire block of the substrate have a surface roughness, rendering the claims anticipated by Nishihara.

The examiner does not agree with appellant's argument that Nishihara et al. implicitly refer to the top surface of the substrate as having the surface roughness. Appellant states that *"Nishihara specifically describes forming a polished and clean surface in each of*

*the resonator cavities. Nishihara, col. 3, lines 12-27."* However, the passage in column 3, lines 12-27 recites the structure of figure 22, which is disclosed in publication JP-A-200-69594. The claims, on the other hand, are rejected over the structure of figure 21 which is disclosed in publication JP-A-60-189307 (see column 2, lines 45-46). Therefore, the fact that the surface of the resonator cavity (which is not the substrate) of the device of JP-A-200-69594 is polished and cleaned, does not mean that the surface of the resonator cavity and/or the substrate of the device of JP-A-60-189307 is polished and cleaned. In fact, the above passage indicates that there is acknowledgement in publications if elements are polished and cleaned. This implies that lack of recitation that elements are cleaned and polished in the device of JP-A-60-189307, means that no element is polished and cleaned. If no element is polished and cleaned, then the entire substrate has a rough surface. Note that it is also well known in the art that lack of cleaning and polishing leaves the surface of the element rough.

In the same token, regarding appellant's argument that *"Nishihara describes the formation of smooth features on the resonator results in a production efficiency that is substantially higher. Nishihara, col. 6, lines 6-16"*, it should be noted that the above passage refers to Nishihara's invention, which is described in the embodiments of figures 1-19, and not to the device of JP-A-60-189307, which is depicted in figure 21.

Regarding appellant's statement that *"Therefore, the only correlation between the sacrifice layer and the substrate appears to be on the top surface (i.e., the surface closest to the cavity and the electrodes in Fig. 21)"*, the examiner could not find any evidence supporting the above statement. Furthermore, even if Nishihara et al. implicitly refer to the top side of the substrate as having a rough surface, there is no implicit teaching that only the top

side of the substrate has a rough surface. In order for only the top side of the substrate to have a rough surface, the bottom side must be polished and cleaned. There is no evidence in the embodiment of figure 21 for polishing and cleaning only the bottom side of the substrate. Thus, it is understood from Nishihara et al.'s passage in column 3, lines 4-6 that the entire substrate block has a rough surface, which includes the top side and the bottom side.

Regarding appellant's argument that since Nishihara does not disclose an uneven surface on a rear side of the substrate, then "Nishihara fails to disclose an uneven surface to suppress a spurious mode", it should be noted that if Nishihara et al. teach an uneven surface on a rear side of the substrate, then the uneven shape of the surface will inherently suppress a spurious mode.

2. Appellant argues on pages 8-10 that *"it would not have been obvious to modify Nishihara to include an uneven surface"*, because *"evidence within the disclosure of Nishihara is presented which directly contradicts the Examiner's suggested modification"*. Appellant further argues that the examiner's reasoning *"is unclear and further gives no rational underpinning to support the asserted conclusion of obviousness"*, and *"the Examiner does not provide reasoning to show how an uneven surface on the side of the substrate that faces away from the bottom electrode would improve adhesion between the substrate and the device structure"*.

2. The examiner will address appellant's argument by explaining how the claims are anticipated by and/or obvious over Nishihara et al.

Nishihara et al. recite in the passage in column 3, lines 4-6 that *"the sacrifice layer, formed to have a thickness corresponding to the length L15, has a greater surface roughness than that of the silicon substrate 810".* Appellant acknowledges (throughout the appeal brief) that Nishihara et al. teach a substrate having a rough surface. Thus, the only issue in hand is whether said passage means that the uneven surface is located "on a rear side of the substrate facing away from the bottom electrode", as required by the claims. Without conceding that the claimed language requires that the uneven surface must be the surface which is not in direct contact with any element, Nishihara et al. teach the claimed limitation for the following reasons:

Since Nishihara et al. do not explicitly state which surface of the substrate is rough, the passage in column 3, lines 4-6 means that there are only three possible structures pertaining to the claimed limitation.

1. The entire substrate block has a rough surface.

2. Only the bottom side of the substrate has a rough surface.

3. Only the top side of the substrate has a rough surface.

Considering the first and second structures:

Having the first and second structures mean that the bottom side of the substrate has a rough surface. Since the bottom side of the substrate has a rough surface, then the claims are anticipated by Nishihara et al. Note that since Nishihara et al. do not state in the embodiment of figure 21 that any element in the structure is polished and cleaned, then it is understood that the entire substrate block has a rough surface.

Considering the third structure:

The presence of the third structure, which is appellant's main argument, means that only the top side of the substrate has a rough surface. This means that the bottom side of the substrate must be polished and cleaned (If the bottom side of the substrate is not polished and cleaned, then the bottom side of the substrate is also rough, and the claims are anticipated by Nishiraha et al.). In this regard, there is no evidence for appellant's argument that only the bottom side of the substrate is polished and cleaned, while the top side of the substrate remains rough. Therefore, Nishihara et al.'s statement that the substrate has a rough surface means that the entire substrate block has a rough surface. However, as unlikely as the presence of the third structure is, the examiner considered this possibility and rejected the claims as being obvious over Nishiahara et al.

The reasons for modifying Nishihara et al.'s structure are as follow. The third structure establishes that Nishihara et al.'s structure is formed on a substrate block whose top surface is rough and its bottom surface is smooth (polished and cleaned). That is, when forming the device, Nishihara et al. is presented with a substrate block having a rough surface and a smooth surface. Nishihara et al. build his structure on the rough side (as argued by appellant) of the substrate, while the smooth surface of the substrate is on the bottom side (as required by the third structure). The examiner suggests modifying Nishihara et al.'s device by forming Nishihara et al.'s structure on the smooth side of the substrate, instead of forming Nishihara et al.'s structure on the

rough side of the substrate. The motivation to form Nishihara et al.'s structure on the polished and cleaned surface of the substrate is to improve the device characteristics by improving the adhesion between the substrate and the structure. The benefits of adhering a structure on a smooth surface versus adhering the structure on a rough surface is also acknowledged by appellant who states that bonding on rough surface reduce the amount of contact are for bonding ("the rough surface area would reduce the amount of contact area of the substrate that would otherwise facilitate anodic bonding", page 9, last paragraph of the brief).

Conclusion:

Nishihara et al. teach a substrate having a rough surface, without explicitly stating which surface of the substrate is rough. The claims require that the bottom side of the substrate has a rough surface. There are only three possible structures as to the location of the roughness. All three possible structures were considered and analyzed. It was shown that the claims are either anticipated by Nishihara et al. or are obvious over Nishihara et al., depending on the location of the roughness. Therefore, Nishihara et al. teach the claimed structure.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

O.N.

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